

ARM AND HAND MOVEMENTS

DECODED FROM
PERSONS WITH
SPINAL CORD INJURY

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INTRODUCTION

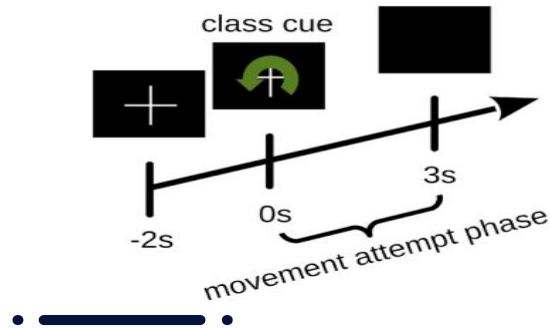


- ❖ The persons with spinal cord injury (SCI) retain decodable neural correlates of attempted arm and hand movements.
- ❖ However, we observe that discriminative movement information was provided by time-domain of low-frequency electroencephalography (EEG) signals.
- ❖ Thus, a BCI device can detect these user induced changes in brain-signals and transform them into control signals for neuroprostheses or robotic arms

DATASET DESCRIPTION

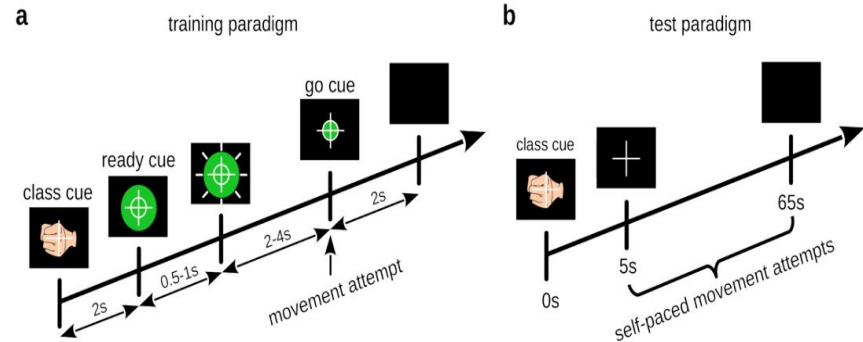
Offline Paradigm

The data set comprises 15 runs per participant: 9 attempted movement runs, 3 eye movement runs, and 3 rest runs. Every run is stored in a separate GDF file.



Online Paradigm

The data set contains GDF files for two online sessions. The first online session includes 9 training runs and 6 test runs; the second online session includes also 9 training runs but 5 test runs.



LITERATURE REVIEW

AUTHOR AND YEAR	TITLE	METHODOLOGY	EVALUATION PARAMETERS	DRAWBACKS
Ofner, P., Schwarz, A., Pereira, J., Wyss, D., Wildburger, R., & Müller-Putz, G. R. (2019) - Scientific reports, 9(1), 1-15.	Attempted arm and hand movements can be decoded from low-frequency EEG from persons with spinal cord injury. [2]	1. Movement classification. <ul style="list-style-type: none"> - Paradigm - Recording - Preprocessing - Classification 2. Proof-of-concept of an online classifier. <ul style="list-style-type: none"> - Paradigm. - Detection thresholds. - Defining the true-positive window 	True positives (TP): Predicted positive and are actually positive. False positives (FP): Predicted positive and are actually negative. True negatives (TN): Predicted negative and are actually negative. False negatives (FN): Predicted negative and are actually positive. Confusion Matrix = $\begin{bmatrix} TP & FN \\ FP & TN \end{bmatrix}$	1. Improve the classifier's generalization capabilities as MRCPs depend on various factors, like force, speed, goal-directedness and attention diversion.

EXPERIMENTAL SETUP

- ❖ Users performed cue-guided setup. There were shown one of the 5 cue classes: pronation, supination, palmar grasp, lateral grasp or hand open.
- ❖ Users were asked to focus their gaze on the cross which was displayed during the whole trial period of 5s and then the class cue was displayed 2s after the trial start for 3s.
- ❖ After the trial, a break with a random duration of 1s to 3s followed.
- ❖ Total of 9 runs with 40 trials per run, i.e. 72 trials per class in total were recorded.
- ❖ Total of 10 users participated in this experiment with ages from 20-69.



CLASSIFICATION ALGORITHM

sLDA classifier

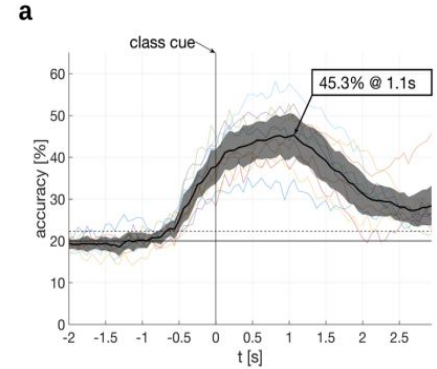
- Shrinkage linear discriminant analysis (sLDA) .
- Input to the sLDA classifier were the EEG samples from all low noise channels.
- EEG samples spaced in 200ms intervals were taken from a time window, i.e. the feature extraction window, and fed into the classifier.
- The output of the classifier was normalized with a softmax function to obtain probabilities.



RESULTS

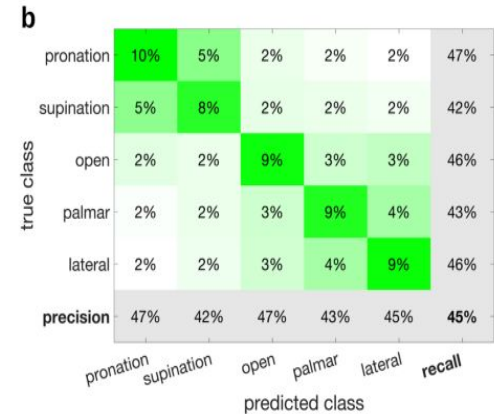
1) Movement Classification:

- This was done with a shrinkage linear discriminant analysis (sLDA) classifier.
- It yielded a grand average accuracy, which peaked with 45.3% at 1.1 s after class cue presentation as shown in the figure.
- The confidence interval at this peak was found out to be [40.3%, 50.3%].



2) Proof-of-Concept classifier:

- The feature extraction window was shifted along the trial in steps of 1/16th of a second, and calculated classification accuracies were validated with a trial-based 10×10 cross-fold validation.
- It shows a modest classification performance of 68.4% with respect to palmar grasp vs hand open classes.



TEAM MEMBERS

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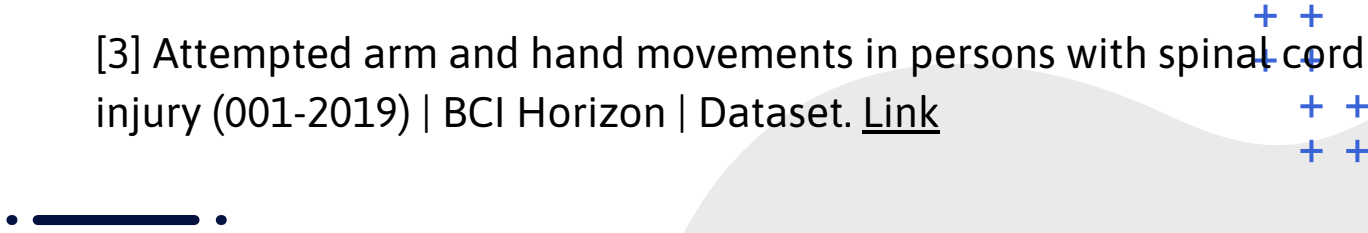


REFERENCES

[1] BCI Horizon | (001-2019) Dataset Description PDF. [Link](#)

[2] Ofner, P., Schwarz, A., Pereira, J., Wyss, D., Wildburger, R., & Müller-Putz, G. R. (2019). Attempted arm and hand movements can be decoded from low-frequency EEG from persons with spinal cord injury. Scientific reports, 9(1), 1-15. [Link](#)

[3] Attempted arm and hand movements in persons with spinal cord injury (001-2019) | BCI Horizon | Dataset. [Link](#)



THANKS



Do you have any questions?

